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# Localized Blood Occlusion Generation in an In-Vitro Circulatory Catheter System

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## ABSTRACT

Hydrocephalus is a debilitating neurological disorder that involves the accumulation of cerebrospinal fluid in a ventricle of the brain. The implantation of a catheter commonly treats hydrocephalus with drainage. These catheters have a short lifespan due to obstruction from biological materials. Shunt systems have an extremely high failure rate of more than 40% failed within 1 year and up to 85% failed within 10 years. Previously, polymer-based flexible implantable magnetic micro-actuators were developed to clean up the catheter by mechanical vibration. We have demonstrated clearing of bacteria attachment and are proceeding to examine clearing effects on larger clotting materials, such as blood clots. A benchtop in-vivo blood circulatory system was created to simulate flow conditions. To prove device viability there must be a succinctly created, localized, consistent occlusion of the catheter. Targeted outcomes include clotting within a 20-30 minute time frame, consistent pressure at occlusion, and controlled clot location. Fibrin was applied to control the location of the clotting and to accelerate the occlusion. Contributing factors that were examined are the method of fibrin application, blood density, and protamine sulfate application. Testing has shown the necessity of blood density of 50% or higher for occlusion. Blood tested at 10% density rarely clotted. In comparison of differing fibrin coating applications, an externally supported coating was found to occlude within the desired parameters at the highest rate of any tested method and was found to be the most reliable method with 60% of tests occluding before 30 minutes and 80% occluding.

## KEYWORDS

Hydrocephalus, MEMS, Benchtop blood model, localized occlusion